EXPLORING THE EVALUATION OF CREATIVE COMPUTING WITH PIXI

A Thesis
Presented to
The Academic Faculty

by

Justin Le

In Partial Fulfillment
of the Requirements for the Degree
Computer Science in the
College of Computing

Georgia Institute of Technology
May 2016

EXPLORING THE EVALUATION OF CREATIVE COMPUTING WITH PIXI

Approved by:

Betsy DiSalvo
School of Computer Science
Georgia Institute of Technology

Gregory Abowd
School of Computer Science
Georgia Institute of Technology

TABLE OF CONTENTS

SUMMARY

Artificial intelligence is rapidly growing as a field of study. It is being developed to act as humans do and perhaps perform better. AI programs are learning to play chess and Go, two classic strategy games, and are beating renowned players. These programs, Deep Blue and AlphaGo respectively, are said to be winning games. However, in the creative computing world, computer programs are viewed as tools like a paintbrush, rather than the creator of a work. Creative works are often attributed to the programmer or the user, not the software. This study seeks to establish whether or not the computer software should be deemed the creator, akin to Deep Blue and AlphaGo being winners, or merely the medium.

CHAPTER 1

INTRODUCTION

With the rise of artificial intelligence there is always some discussion of controversy. In the area of creative and interactive computing, the controversy addresses whether or not the artificial intelligence agent is a creator itself, or merely a tool of the artist, and also addresses the evaluation of the creativity of a system. Because creativity is itself a hard concept to place a value in objectively, there have been many methods developed to evaluate it.

Most methods of evaluating creativity observe the process of creation rather than the end product. Some prefer a psychological or neuroscience approach and consider the cognitive processes of the artists (López-Ortega 2012). López-Ortega also implements a technological approach, using code to evaluate these cognitive processes. Others prefer to compare the difference between an end product using assistance from an artificially intelligent creator and one without assistance (Johnson, M. D. G.,Hong, and Yi-Luen Do 2008).

Most research has addressed creative works by an artificial intelligence agent and an operator. However, there is little research in the field of creative computer systems designed to interact with a public audience. Of course, there are few computer systems designed specifically for public interaction as it is a growing movement. To whom would the credit of creativity go to in this situation, and by whom should it be evaluated? Would it be the public as a whole, the system, or even the creator of the system?

This project seeks to determine whether the people interacting with a system can evaluate how creative the system is, as well as evaluate how their creativity is expressed in terms of using the system. Another point to be addressed is the creator of the system's part in evaluating creativity.

CHAPTER 2

LITERATURE REVIEW

Humanity has a reached a point in development where technology is so abundant that it is being used for creative pursuits. In fact, technology has evolved to the point where technology itself can create art, music, and literature. Artificial intelligent systems have been developed that will paint, like the robot painter AARON (Sundararajan), or help users compose music by completing compositions for the user. The subject regarding these systems falls under creative computing or computer-assisted creativity. However, some argue that the artificial intelligence was created by a human, and so the creativity is attributed to the creator, and the computer merely a tool. So, the rise in creative works involving artificial intelligent systems gives birth to a new debate: can computers be creative?

The question is a difficult one to answer because creativity is an elusive subject. A popular option to determine to whom the creative credit should be attributed is to measure the amount of creativity produced from the artificial intelligent system and how much is produced from the user of the system. However, creativity is hard to define, let alone hard to evaluate. As such, much effort has been put into defining creativity as has been into evaluating it. Methods of evaluating creativity are incredibly wide in variety. As creativity is often tied to cognition and psychology, some researchers have taken to analyzing the cognitive activity of users while interacting with the creative artificial intelligence.

López-Ortega measures the traits of planning, divergent thinking, accessing knowledge stored in long-term memory, and selective attention in humans and computers to evaluate the creativity of a system. He observed that brains tend to form certain patterns of neuron activity when performing creative actions, and he equates such patterns to case diagrams for computer programs. He further assesses creativity in regards to its code, and additionally tests it *with* code.

Johnson et al. take a less technical approach. They compare the results of a creative work done with assistance from a creative artificial agent against a creative work done without one. After a brief history of sketching tools from pencil and paper to more computationally inclined tools, they compare artificial intelligent creative agents to the previous iterations of sketching tools. Using this analogy, they seek to evaluate how the computer has enhanced the creative output of users. Several other, less conventional, techniques have been developed. One study examines the frequency of words used to describe creativity and a creative work and assigns values to the words in order to sum a value for creativity (van der Velde et al.).

The ambiguity of defining and evaluating creativity has led to a large confusion of defining creative computing and the role of artificial intelligence in creative endeavors. Thus, no concrete method to evaluate creativity has been decided upon, nor has one been decided upon to assign creative credit. Instead, many suggest evaluators to consider the collaborative nature of creativity; the creative process is the work of many influences working together (Bown).

Implications

The current study draws upon this collaborative nature of creative computing by observing how a creative installment can be creative with the help of outside interactions. The system will react to users who are not trained to operate it, creating different patterns of light as a result of the behaviors of the users. As such, both the system and the audience of users will become part of the creative process. This is a new area of study; many creative artificial intelligent agents either operate autonomously or operate in tandem with a user like an artist or musician.

CHAPTER 3

METHODS AND MATERIALS

Materials – PIXI Corset and Dress

The PIXI Corset is a corset lined with LED strips – 8 strips of 80 LEDs for a total of 640. The colors of each individual LED can be programmed. This allows users to design patterns on the corset in real-time. As the users introduce designs, the corset will reflect these designs and alter them, or adapt the design to its environment. For example, should the user sit on a green plastic chair, the microcomputer controlling the corset will recognize the color and adjust the corset's LEDs to match the color of the chair.

The user interface simulates an airbrush; as the user holds down the mouse button to "paint" the color on the dress, the color gradually intensifies in saturation. With the corset connected to the computer, the design will be reflected immediately. Although the software resembles popular photo editing software such as Adobe Photoshop or GIMP, light behaves differently than physical mediums. As such, the user interface mixes colors using the rules of light rather than traditional color theory.

In a similar vein, the dress behaves differently than the corset does. While the LEDs on the corset are fitted externally, the dress is designed with the LED display on the interior. Thus, the light emitted disperses on the fabric of the dress, causing the colors to blend together. The software for the dress accounts for this. The calibration includes a blob detection algorithm that simulates the blending of the LEDs on the dress so that users will know what to expect when designing the dress.

Methods – User Testing

User groups will include students from the School of Industrial Design and College of Computing at Georgia Tech. Students within the College of Computing who have experience in graphics, design, or who have an interest in art are preferred. In doing so, feedback will be received regarding both the performance of the software and the concept of designing the patterns and colors of the corset.

The feedback desired will be divided into three main categories: the designing of the corset, the user interface itself, and the reactionary nature of the dress. Of course, these divisions do not separate into three exclusively distinct parts, much as the feedback of the users will not address each issue separately. Rather, the goal of the distinctions is to offer a method to focus improvements made on PIXI into three concrete areas.

Questions addressing the process of designing PIXI will seek to understand the users' ease in learning how to use the software and accurately portray the design they envision. This is clearly the main concern with testing, and so the feedback should focus on the experience of designing the dress. The user should address both the corset and the dress, as designing each will be a different experience.

The second concern is the user interface. While the user interface certainly functions as it should – it changes the colors of the LEDs – users should provide feedback on being able to use the interface in a way that easily facilitates the design process. They should be able to easily find and use features such as the color picker, adjusting the "brush" size, and saving and loading images.

Addressing PIXI's reaction is slightly harder to evaluate. As this is purely an aesthetic reaction to the user's input, it is a subjective matter. Therefore, feedback

regarding the performance of PIXI's reaction from a functional perspective will be much easier to implement. On the other hand, feedback regarding the patterns that PIXI produces may be taken into consideration, but is not the main concern.

Most importantly, users should discuss how much they felt they were contributing and how much they felt the software was contributing to the design of the dress. Variations of this response may include whether the software transformed the design while maintaining loyalty to the original or changed the design completely, and whether or not the user thought the changes were positive or negative.

CHAPTER 4

RESULTS

There was little difficulty determining how to design PIXI. Users quickly, if not immediately, took to the "paint" option of the software, discovering the ability to change colors and brush size. Because the software mixes colors as light mixes rather than paint, some users had trouble adapting to the mixology. However, this stumble could be quickly rectified due to the color picker having all colors available – the user could simply pick the actual color they desired rather than the color they had mistakenly blended. For example, red and blue paints mix to create purple, but red and blue lights mix to create magenta. Most users would choose purple on the color picker and color over the magenta.

Users had no trouble using the size function of the user interface. Similarly, the hardness and flow functions were easy for users to use independently. However, some problems arose when using the size and flow functions together. When the size was less than the flow, the colors would not appear on PIXI. Users were confused when they encountered this, and most took considerable time to determine the cause of this problem. The depiction of the corset on the user interface also caused trouble. Users had difficulty coloring the back of the corset, often becoming confused as to how the corset's three sides connected. Overall, however, the user of the user interface was successful and not too frustrating.

The responses to the reactions of PIXI were mixed. All users liked some designs that PIXI presented while they disliked others. Most, however, appreciated the intention

of the creative responses. At times, a user would be inspired by PIXI's proposed design, inspiring them to respond in turn.

When PIXI drastically changed the design from the original, a majority of users responded negatively. In contrast, when the alteration was very slight, users did not mind at all, and were not upset that more change did not occur.

Most users felt that they were contributing more to the design of the dress than the PIXI software was. On the occasion that the user would have a "back and forth" design with the software, in which the user decides to expand upon PIXI's new design, users felt that the design was more collaborative.

CHAPTER 5

DISCUSSION AND CONCLUSION

Discussion

Because the color picker provided most colors, the issue of users being confused with the mixology of colors differing between light and other physical media did not seem to be a major concern. As expected, this part of the evaluation went very smoothly. The problem regarding the use of size and flow was merely a bug in the software's code, so was an easy fix. The problem regarding the coloring of the back of the corset was a more interesting problem. The UI shows the back of the corset in a mirror in order to show the entire corset in one view because the corset cannot be unwrapped and laid flat. The left side of the front of the corset maps to the leftmost side of the back of the corset, and so does not connect intuitively. This is visually explained in Figure 1. There was some discussion about how this should be fixed, but the result was to mirror the back image of the corset so that the corset would feel as though it were, in fact, unwrapped.

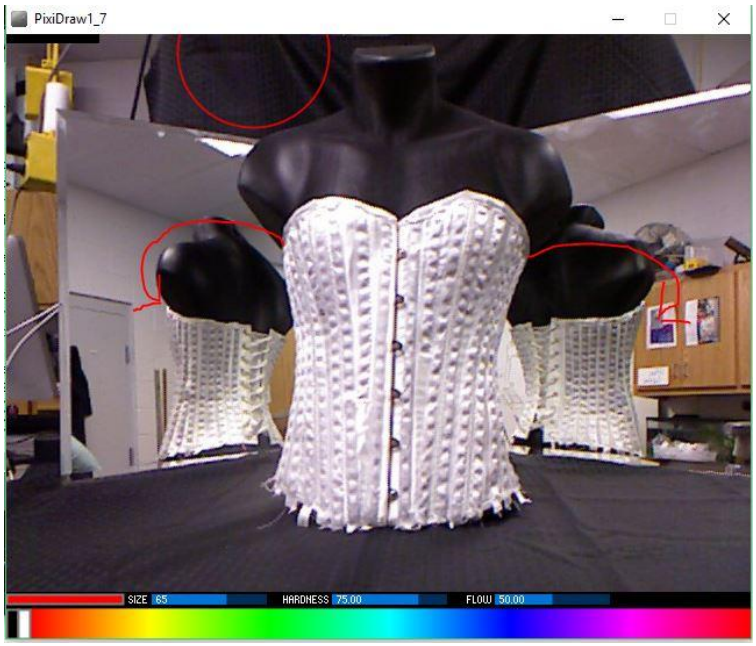

Figure 1

The expectation was that users would respond with mixed reviews about PIXI's reactionary designs. Users would like some designs while disliking others, as the variety of options that PIXI presents is numerous. However, users viewed the software as mainly

a design tool, with the feature of PIXI changing the design merely being a feature, as exemplified when users did not mind that PIXI did not change their design much but becoming frustrated when PIXI changed the design *too* much. Because PIXI is intended to be used practically for design, the solution to this was to add the choice to have PIXI suggest new designs as well as an undo, rather than do so automatically and irreversibly.

Unfortunately, the intention of the user testing was to explore PIXI's own suggestions and users reactions to them. The collaborations in which the user would take PIXI's proposed design and use it to create another response were, to this goal, most successful. The users felt as though they were collaborating with another creative entity.

Conclusion

Users who experienced a back-and-forth design experience with PIXI felt as though they had collaborated with the software, and attributed part of the design to PIXI. They received inspiration from PIXI's responses to their own designs, thereby advancing their creativity, producing a design they would not have produced without the software. This stipulation, that users reached levels of creativity they would not have without the computationally creative agent, may be a valuable method of evaluating creativity.

CHAPTER 6

FUTURE WORK AND RECOMMENDATIONS

Future goals aim to expand the capabilities of the corset in regards to designing itself in response to stimuli, whether that is the environment or a designer. For example, reaching beyond recognizing the color of the immediate environment, the corset may respond to the noise level of the area, or to the temperature.

Future tests may be divided into different categories: functionality of PIXI and the creativity and collaborative factor. While there were encouraging responses in collaborating with PIXI, the users did not focus on that aspect of the software; they were more interested in the design portion. If a test were presented that focused on the creative experience of PIXI, feedback would be much more helpful.

When testing purely for creativity, users could be asked to collaborate with PIXI whether they liked the design or not. After one or two rounds of designing back and forth, the user can be asked whether or not they feel as though PIXI helped them design more creatively.

REFERENCES

Anna Kantosalo, J. M. T., Hannu Toivonen. (2015). Interaction Evaluation for Human-Computer Co-creativity: A Case Study.

Bown, O. (2015). Attributing Creative Agency: Are we doing it right?

Johnson, Gabe, M. D. G., Hong, Jason and Yi-Luen Do, Ellen. (2008). Computational Support for Sketching in Design: A Review. *Foundations and Trends in Human–Computer Interaction 2*(1).

López-Ortega, O. (2012). Interaction Evaluation for Human-Computer Co-creativity: A Case Study. *Elsevier*.

Sundararajan, L. (2014). Mind, Machine, and Creativity: An Artist's Perspective. *Journal of Creative Behavior, 48*(2), 136-151.

van der Velde, Frank, R. A. W., Schmettow, Martin and Deniece S. Nazareth (2015). A Semantic Map for Evaluating Creativity